



This document contains Part 3 (pp.144–162) of Chapter 5 of the National Coastal Condition Report III.

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National Coastal Condition Report III
Chapter 5: Gulf Coast Coastal Condition
Part 3 of 3

December 2008

Trends of Coastal Monitoring Data—Gulf Coast Region

Temporal Change in Ecological Condition

The coastal condition of the Gulf Coast region has been assessed since 1991. EMAP-Estuarines conducted annual surveys of estuarine condition in the Louisianian Province from 1991 to 1994; this province extends from the Texas-Mexico border to just north of Tampa Bay, FL. The results of these surveys were reported in the NCCR I (U.S. EPA, 2001c). EMAP-NCA initiated annual surveys of coastal condition in the Gulf of Mexico in 2000, and these data were reported in the NCCR II. Data from 2001 and 2002 are assessed in the current report (NCCR III). Seven years of monitoring data from Gulf Coast coastal waters provide an ideal opportunity to investigate temporal changes in ecological condition indicators. These data can be analyzed to answer two basic types of trend questions based on assessments of ecological indicators in Gulf Coast coastal waters: what is the interannual variability in proportions of area rated good, fair, or poor, and is there a significant change in the proportion of poor area from the early 1990s to the present?

The parameters that can be compared between the two time periods include the dissolved oxygen, water clarity, sediment contaminants, sediment toxicity, and sediment TOC component indicators, as well as the benthic index. Data supporting these parameters were collected using similar protocols and QA/QC methods. Although EMAP-NCA also evaluated chlorophyll *a* and nutrients as part of its assessment of water quality, these component indicators were not collected during the EMAP-Estuarines surveys from 1991 to 1994. Both programs implemented probability-based surveys that support estimations of the percent of coastal area in good, fair, or poor condition based on the indicators. Standard errors for these estimates were calculated according to methods listed on the EMAP Aquatic Resource Monitoring Web site (<http://www.epa.gov/nheerl/arm>). The reference values and guidelines

listed in Chapter 1 were used to determine good, fair, or poor condition for each index and component indicator from both time periods.

In order to compare indices and component indicators across years from the same geographic area, the spatial extent of the EMAP-NCA Gulf Coast data was reduced to match that of the Louisianian Province monitored by EMAP-Estuarines. Therefore, EMAP-NCA data collected in Florida between Tampa Bay and Florida Bay were excluded from this temporal comparison. In addition, no data were collected from the entire region between 1995 and 1999.

Only water clarity and dissolved oxygen data were available for the comparison of water quality conditions from 1991 to 2002. Neither of these component indicators showed a significant linear trend over time in the percent area rated in poor condition (Figures 5-10 and 5-11). However, when the two time periods were compared, significantly more of the coastal area was rated poor for water clarity in the 2000–2002 time period than in the 1991–1994 time period ($z = 4.252$; $p < 0.05$).

Water quality indicators are more likely to be influenced by interannual variation in climate than by long-term trends. To examine the potential

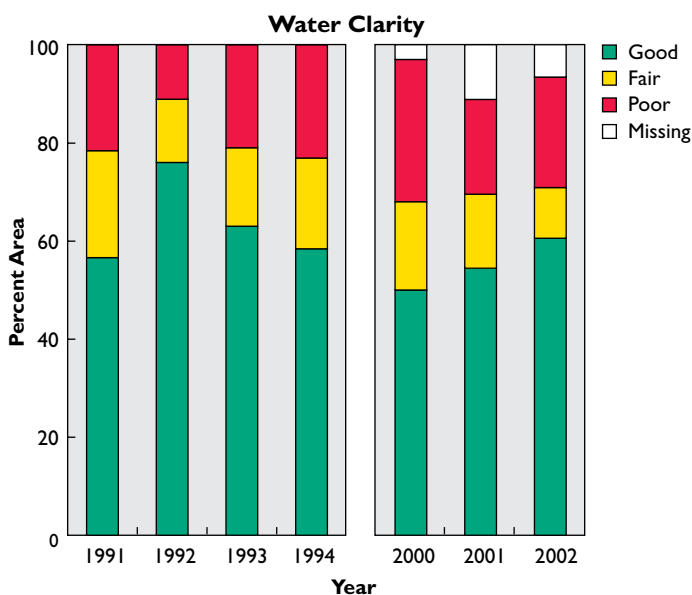


Figure 5-10. Percent area of Gulf Coast coastal waters in good, fair, poor, or missing categories for water clarity measured over two time periods, 1991–1994 and 2000–2002 (U.S. EPA/NCA).

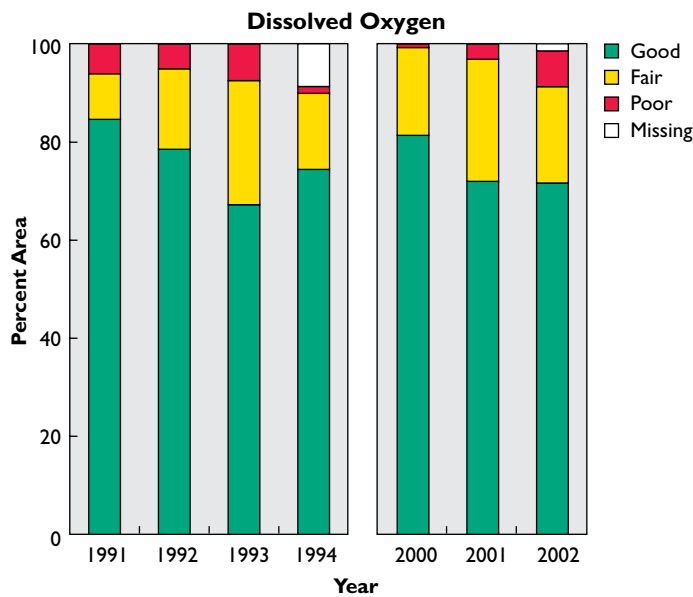


Figure 5-11. Percent area of Gulf Coast coastal waters in good, fair, poor, or missing categories for bottom-water dissolved oxygen measured over two time periods, 1991–1994 and 2000–2002 (U.S. EPA/NCA).

effects of interannual variation in climate on dissolved oxygen, the relationship between annual rainfall and the percent area in good condition for dissolved oxygen was examined. The estimated annual rainfall for the Gulf Coast was calculated as the sum of annual estimates for five states (Texas, Louisiana, Mississippi, Alabama, and Florida) using

precipitation data available from NOAA (NOAA, 2007i). Linear regression resulted in a significant relationship between the percent coastal area in good condition for dissolved oxygen and annual rainfall estimates ($R^2 = 0.225$; $p < 0.05$). This linear relationship was used to predict the percent coastal area rated good for dissolved oxygen from 1995 to 1999, when data were not collected (Figure 5-12).



Shrimp trawlers and cactus—a seemingly incongruous but normal sight in south Texas (courtesy of William B. Folsom, NMFS).

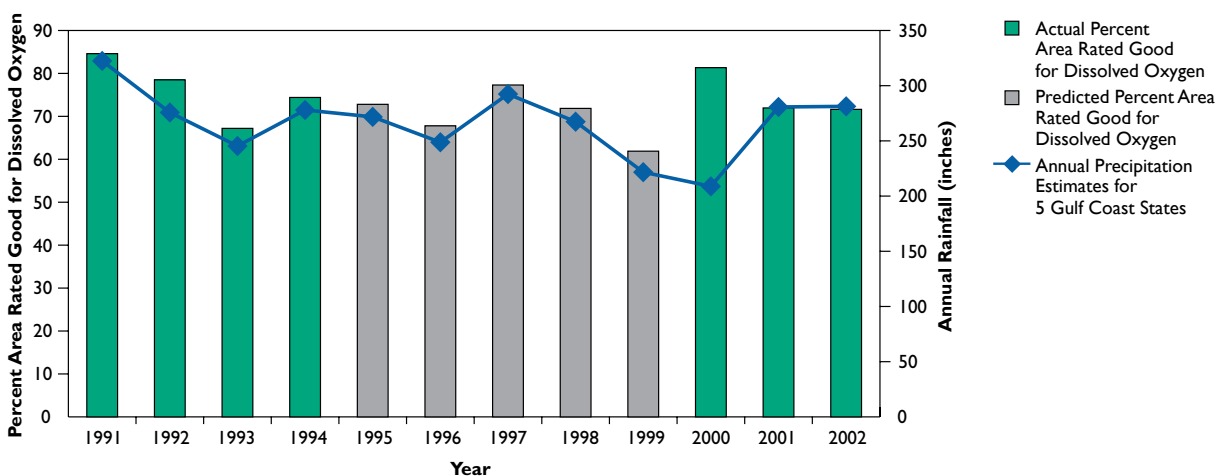


Figure 5-12. Percent area of Gulf Coast coastal waters with bottom-water dissolved oxygen concentrations > 5 mg/L (rated good) compared to annual precipitation estimates for the five Gulf Coast states from 1991 to 2002. Predicted dissolved oxygen levels from 1995 to 1999 are based on the significant linear relationship between percent area with good dissolved oxygen and rainfall (U.S. EPA/NCA).

The sediment quality component indicators available for comparison were sediment contaminants, sediment toxicity, and sediment TOC. None of these indicators showed a significant linear trend in the percent coastal area rated in poor condition from 1991–2002 (Figures 5-13, 5-14, and 5-15). There was also no significant difference

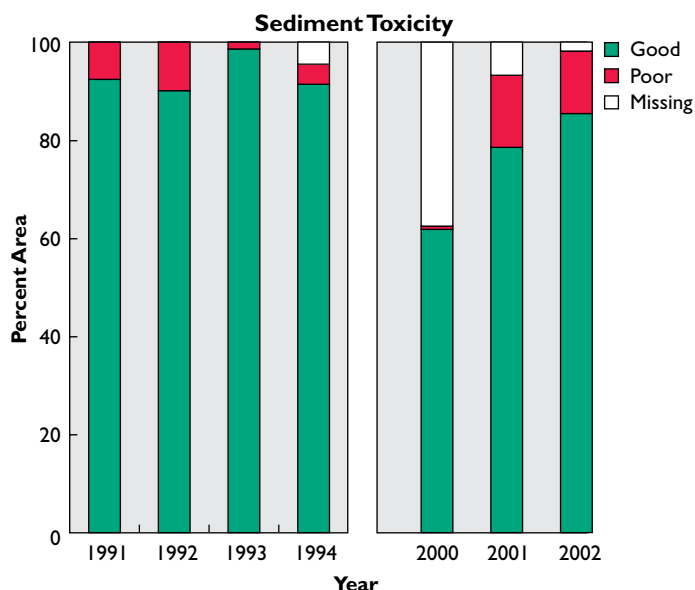


Figure 5-13. Percent area of Gulf Coast coastal waters in good, poor, or missing categories for sediment toxicity measured over two time periods, 1991–1994 and 2000–2002 (U.S. EPA/NCA)

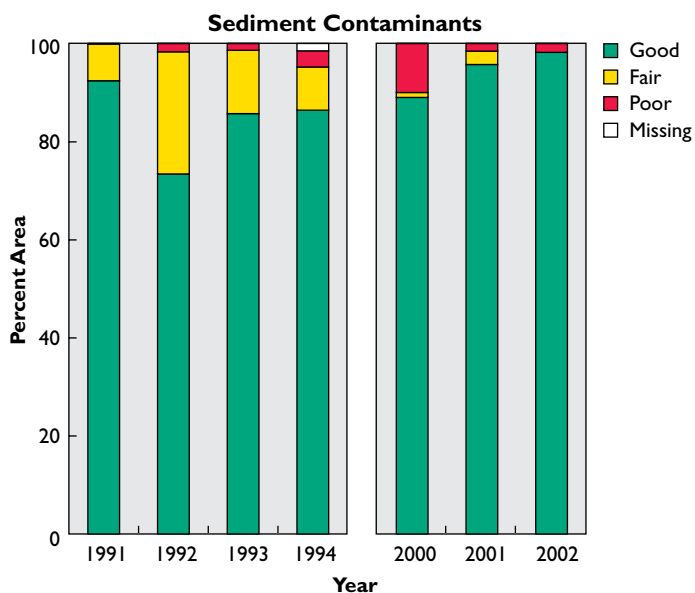


Figure 5-14. Percent area of Gulf Coast coastal waters in good, fair, poor, or missing categories for sediment contaminants measured over two time periods, 1991–1994 and 2000–2002 (U.S. EPA/NCA).

in the percent area rated poor for these component indicators between the 1991–1994 and 2000–2002 time frames; however, the percent area rated good for sediment contaminant concentrations significantly increased ($R^2 = 0.77$; $p < 0.05$) from 1992–2002, as shown in Figure 5-13. Although the percent area rated poor remained stable, the sediment contaminants component indicator has improved in Gulf Coast coastal waters, as indicated by a significant decrease ($z = 3.96$; $p < 0.05$) in the total percent area rated poor and fair, combined, from 16.4% in 1991–1994 to 5.9% in 2000–2002.

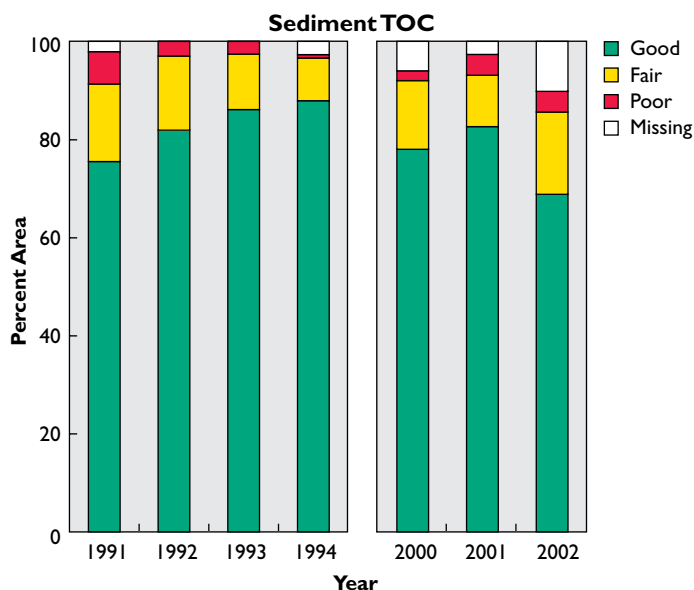


Figure 5-15. Percent area of Gulf Coast coastal waters in good, fair, poor, or missing categories for sediment TOC measured over two time periods, 1991–1994 and 2000–2002 (U.S. EPA/NCA).

The benthic index for Gulf Coast coastal waters is a multimetric indicator of the biological condition of benthic macroinvertebrate communities. Biological condition indicators integrate the response of aquatic organisms to changes in water quality and sediment quality over time. Benthic condition degraded from 1991 to 2002, as indicated by a significant increase in the percent area rated poor from 1991–1994 to 2000–2002 ($z = 4.68$; $p < 0.05$) and a significant negative trend in the percent area rated good ($R^2 = 0.61$; $p < 0.05$) (Figure 5-16).

In summary, sediment quality in Gulf Coast coastal waters improved between the time periods 1991–1994 and 2000–2002, whereas both water clarity and benthic community condition worsened over these same time periods (Figure 5-17).

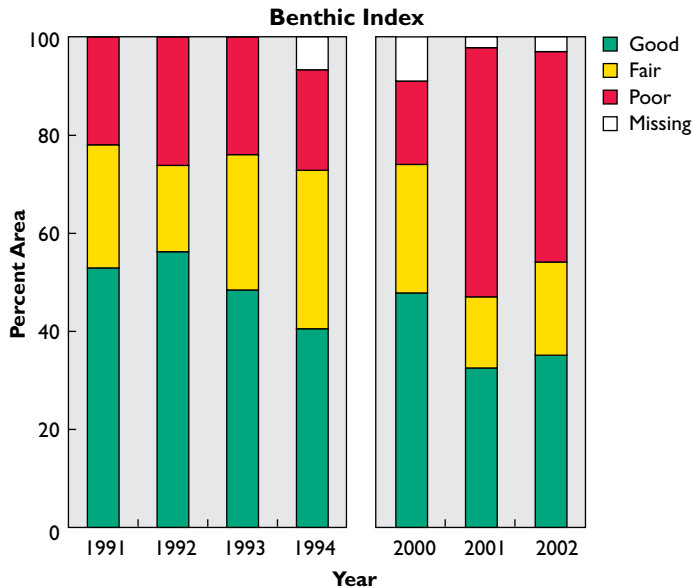


Figure 5-16. Percent area of Gulf Coast coastal waters in good, fair, poor, or missing categories for the benthic index measured over two time periods, 1991–1994 and 2000–2002 (U.S. EPA/NCA).



Little blue herons, such as this one resting in Charlotte County, FL, breed in estuarine and freshwater habitats in the Gulf Coast and Southeast Coast regions (courtesy of Kevin T. Edwards, IAN Network).

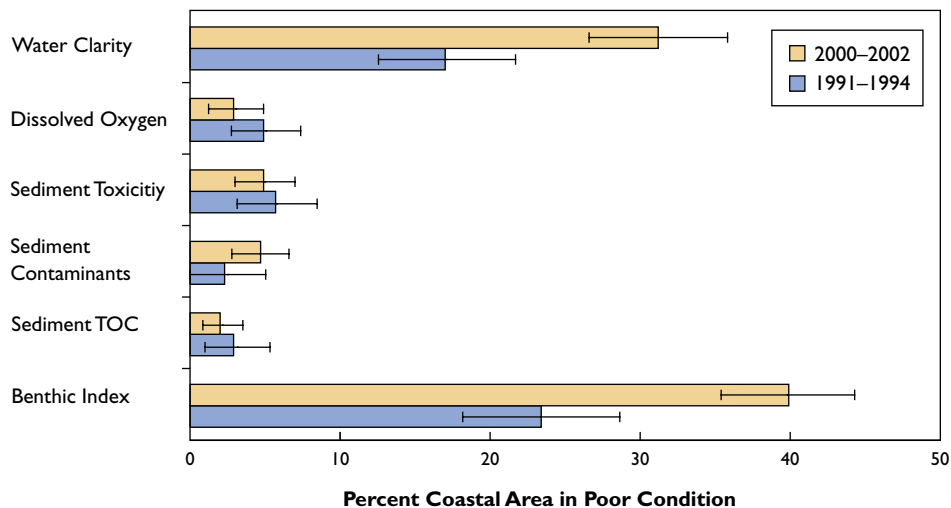


Figure 5-17. Comparison of percent area of Gulf Coast coastal waters rated poor for ecological indicators between two time periods, 1991–1994 and 2000–2002. Error bars are 95% confidence intervals (U.S. EPA/NCA).

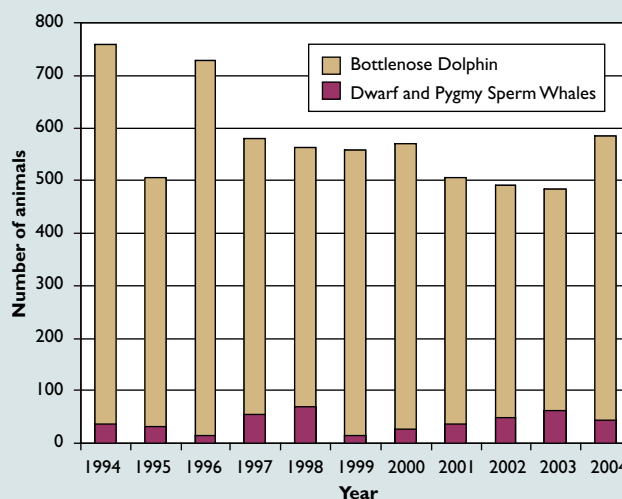


Summary of Marine Mammal Strandings along the Gulf and Southeast Coasts

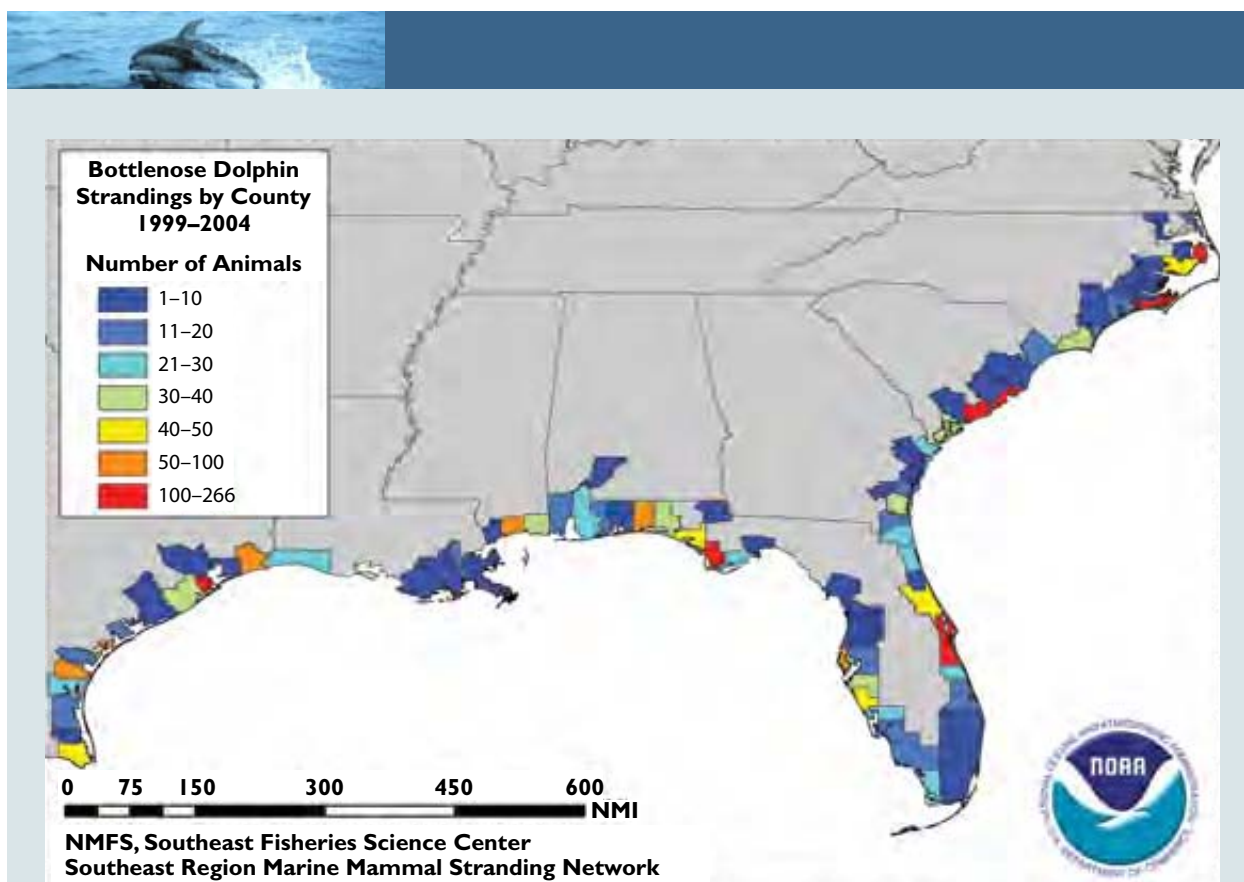
Strandings of marine mammals are a common event along the U.S. coast between North Carolina and Texas. These events involve both live and dead cetaceans (a type of marine mammal) and can include strandings of individual animals, mass strandings (where a large group of animals strand at the same time), and UMEs, which can be extended, large-scale events with elevated stranding rates. Data on marine mammal strandings in the Southeast and Gulf Coast regions are collected by the Southeast Region Marine Mammal Stranding Network, which is a diverse group of non-profit organizations, academic institutions, private research institutions, and state and local agencies that volunteer time to respond to and collect data from stranded marine mammals. Each organization, institution, or agency in the network has a regional area of primary responsibility, but resources are often shared, particularly when responding to mass strandings or UMEs. The network's activities are coordinated through the NMFS Southeast Fisheries Science Center and the Southeast Regional Office, with the support of the National Marine Mammal Health and Stranding Response program at NMFS headquarters.

The most commonly stranded species are the bottlenose dolphin (*Tursiops truncatus*) and the dwarf and pygmy sperm whales (*Kogia sp.*). Together, these species have accounted for 73% of the stranded animals, on average, over the past decade. Members of many other cetacean species are stranded throughout the region, including offshore delphinids, sperm whales, and baleen whales. An average of 575 bottlenose dolphins and 40 dwarf and pygmy sperm whales have stranded each year in the Southeast and Gulf Coast regions over the past decade, and the number of animals stranding each year has remained relatively constant throughout that time period (see graph). Geographically, the strandings are not distributed evenly and include several “hot spots,” where the number of animals stranding each year is relatively high. Notable hot spot areas include the Indian River Lagoon system along the central Atlantic coast of Florida; the area around Charleston, SC; and along the entire coastline and estuarine areas of North Carolina (see map). It should be noted that the observed spatial patterns also reflect variations in the ability to detect stranded animals. Along the Gulf Coast of the United States, the complexity of the coastline (including expansive marsh areas) and a generally lower level of local coverage by the stranding network results in notable gaps along the Florida panhandle and the central Louisiana coast (NOAA, 2006c).

One of the primary goals of the stranding network is to assess the underlying causes for stranding events. Extensive data-collection protocols and training efforts exist to allow network members to record observations on each stranded animal, collect tissue samples, and conduct autopsies to provide information on the

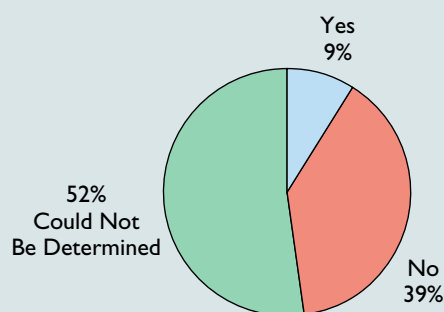


The number of bottlenose dolphins and dwarf and pygmy sperm whale strandings in the Southeast and Gulf Coast regions between 1994–2004. These data include only individual stranding events and do not reflect either mass strandings or UMEs (courtesy of Southeast Region Marine Mammal Health and Stranding Response Network).



Individual bottlenose dolphin strandings by county in the Southeast and Gulf Coast regions between 1999 and 2004. The number of events recorded in each county reflects both the rate of strandings and the ability of the local network to detect stranding events (courtesy of Southeast Region Marine Mammal Health and Stranding Response Network).

health and physiological condition of animals, where possible. In addition, carcasses are examined to determine if human interactions (primarily with fishery activities) resulted in mortality. For 52% of stranded bottlenose dolphins, it was not possible to determine if human interaction contributed to the stranding because of the advanced state of carcass decomposition. Evidence of human interactions was documented for 9% of the total number of animals stranded between 1999 and 2004 (see figure). Other causes for marine mammal strandings may include predation, disease, exposure to environmental toxins or pollutants, and juvenile and neonate mortality. Directly identifying the cause of an event is often difficult, and evaluating the correlations between strandings and environmental conditions, human activities, habitat quality, exposure to pollutants, and other factors is a major research effort within NMFS (NOAA, 2006c).



Individual bottlenose dolphin strandings between 1999 and 2004, categorized by whether human interaction resulted in mortality (courtesy of Southeast Region Marine Mammal Health and Stranding Response Network).

Large Marine Ecosystem Fisheries—Gulf of Mexico LME

The Gulf of Mexico LME extends from the Yucatan Peninsula, Mexico, to the Straits of Florida, FL, and is bordered by the United States and Mexico (Figure 5-18). In this tropical LME, intensive fishing is the primary driving force, with climate as the secondary driving force. The Gulf of Mexico is considered a moderately productive LME based on global estimates of primary production (phytoplankton); however, the productivity of this LME is complex and influenced by a variety of factors of different scales. These factors include wave effects, tides, river flow, and seasonal variations in atmospheric conditions (NOAA, 2007g).

The Gulf of Mexico is partially isolated from the Atlantic Ocean, and the portion of the Gulf of Mexico LME located beyond the continental shelf is a semi-enclosed oceanic basin connected to the Caribbean Sea by the Yucatan Channel and to the Atlantic Ocean by the Straits of Florida. Through the narrow, deep Yucatan Channel, a warm current of water flows northward, penetrating the Gulf of Mexico LME and looping around or turning east before leaving the Gulf through the Straits of Florida. This current of tropical Caribbean water is known as the Loop Current, and, along its boundary, numerous eddies, meanders, and

intrusions are produced and affect much of the hydrography and biology of the Gulf. A diversity of fish eggs and larvae are transported in the Loop Current, which tends to concentrate and transport early life stages of fish toward estuarine nursery areas, where the young can reside, feed, and develop to maturity (NMFS, In press).

Reef Fish Resources

Reef fishes include a variety of species (e.g., grouper, amberjack, snapper, tilefish, rock and speckled hind, hogfish, perch) that live on coral reefs, artificial structures, or other hard-bottom areas. Reef fish fisheries are associated closely with fisheries for other reef animals, including spiny lobster, conch, stone crab, corals and living rock, and ornamental aquarium species. Reef fish share many long life-history characteristics and are vulnerable to overfishing due to slow growth and maturity, ease of capture, large body size, and delayed reproduction. Currently, about 100 species in the Southeast U.S. Continental Shelf, Gulf of Mexico, and Caribbean Sea LMEs are managed as a unit by the South Atlantic, Gulf of Mexico, and Caribbean Fishery Management councils. Combined commercial and recreational landings of reef fish from the Gulf of Mexico LME have fluctuated since 1976 and show a slightly increasing trend over time. Meanwhile, fishing pressure in this



Figure 5-18. Gulf of Mexico LME (NOAA, 2007g).

region has increased significantly. Of the dominant reef fish within the U.S. waters of the Gulf of Mexico LME, the red snapper and red grouper stocks are currently overfished, and the gag grouper and greater amberjack stocks are approaching an overfished condition (NMFS, In press).

NOAA prohibits the use of fish traps, roller trawls, and power heads on spear guns within the inshore, stressed area; places a 15-inch total length minimum-size limit on red snapper; and imposes data-reporting requirements. The red snapper fishery has been under stringent management since the late 1990s (NMFS, In press). A stock-rebuilding plan (GMFMC, 2004a) proposed in 2001 provides for bag limits, size limits, and commercial and recreational seasons. This plan is expected to provide stability and predictability in this important fishery for both industry and consumers. Other regulations pertaining to the management of reef fish within the Gulf of Mexico LME include minimum size limits for certain species; permitting systems for commercial fishermen; bag limits; quotas; seasonal closures; and the establishment of Marine Protected Areas that prohibit the harvest of any species at two ecological reserves near the Dry Tortugas off south Florida and the Madison-Swanson and Steamboat Lumps off west-central Florida (NMFS, In press).

The regulatory measures and stock-rebuilding plans currently under way are designed to reduce fishing mortality and to continue or begin rebuilding all these stocks. Reef species form a complex, diverse, multi-species system. The long-term harvesting effects on reef fish are not well understood and require cautious management controls of targeted fisheries and the bycatch from other fisheries within the U.S. waters of the Gulf of Mexico LME.

Menhaden Fishery

Gulf menhaden are found from Mexico's Yucatan Peninsula to Tampa Bay, FL. This species forms large surface schools that appear in nearshore Gulf of Mexico LME waters from April to November. Although no extensive coast-wide migrations are known, some evidence suggests that older fish move toward the Mississippi River Delta. Gulf menhaden may live to an age of 5 years, but most specimens landed are 1 to 2 years old. Landing records for the

Gulf of Mexico LME menhaden fishery date back to the late 1800s; however, the data up to World War II are incomplete. During the 1950s through the 1970s, the commercial fishery grew in terms of the number of reduction plants and vessels, and landings generally increased with considerable annual fluctuations (Figure 5-19). Record landings of 982,800 t occurred in 1984 and subsequently declined to a 20-year low of 421,400 t in 1992. This decline was primarily due to low product prices, consolidation within the menhaden industry, and concurrent decreases in the commercial fishing effort in the northern Gulf of Mexico LME and in the number of vessels and fish factories dedicated to this fishery. Landings in recent years (1998–2002) are less variable, ranging between 486,200 and 684,300 t, with 574,500 t landed in 2002. Average landings from 2001–2003 were 564,000 t. Historically, the geographical extent of Gulf of Mexico LME menhaden fishing ranged from the Florida Panhandle to eastern Texas, and the current extent of the fishery ranges from western Alabama to eastern Texas, with about 90% of the harvest occurring in Louisiana waters (NMFS, In press).

The 1999 stock assessment indicates that the menhaden stock is healthy and that catches are generally below long-term maximum sustainable yield estimates of 717,000 to 753,000 t (NMFS, In press). A comparison of recent fishing mortality estimates to biological reference points does not suggest that overfishing is occurring.

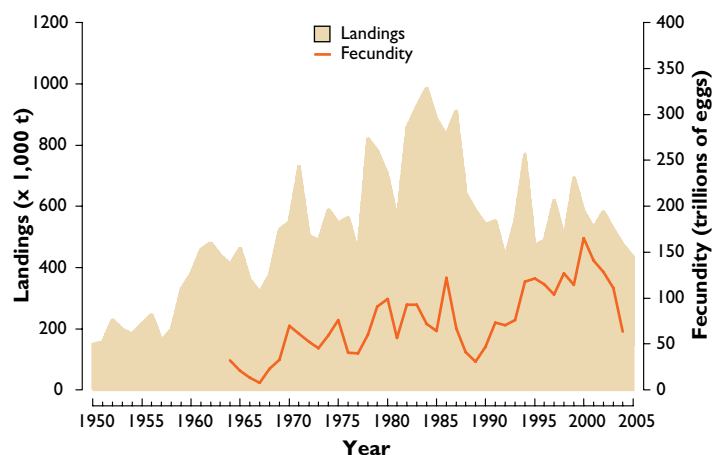


Figure 5-19. Menhaden landings in metric tons (t) and fecundity (trillions of eggs), 1950–2002, Gulf of Mexico LME (NMFS, In press).



Highlight

Gulf of Mexico Harmful Algal Blooms

Karenia brevis, often called the Florida red tide, is a phytoplanktonic organism that has been implicated in the formation of HABs throughout the Gulf of Mexico. In U.S. waters, the blooms occur almost annually during the fall in the waters along the West Florida shelf and less frequently in the waters of the Florida Panhandle, Alabama, and Texas. Only once has a bloom occurred in Mississippi or Louisiana. In addition to discoloring the water, *Karenia brevis* produces brevetoxins, which are potent neurotoxins that can contaminate shellfish and cause neurotoxic shellfish poisoning in humans (FWRI, 2007). Also, *Karenia brevis* can form aerosols along beaches that cause human respiratory problems and can kill fish, marine mammals, turtles, and birds. As a result, these blooms have major impacts on human health, tourism, shellfish industries, and ecosystems.

In January 2005, an unusually early and large bloom of *Karenia brevis* began on the West Florida shelf, resulting in fish kills and respiratory irritation in beachgoers. In 2005, 81 of the 396 manatee deaths (about 20%) in Florida were confirmed positive for brevetoxins (FWRI, 2006). This mortality event, following similar events in previous years, is casting doubt on the sustainability of the southwest Florida manatee subpopulation. In early summer 2005, the bloom receded to a small area in southern Tampa Bay, but then a unique set of oceanographic conditions led to the bloom expanding offshore and being trapped near the bottom. The toxins produced by the algae killed fish and bottom-dwelling organisms, and the dead organisms decayed, using up bottom-water dissolved oxygen. A large area of anoxic and hypoxic bottom water was created, resulting in additional animal mortalities in an area of more than 2,162 mi² located west of central Florida. The last time a similar event occurred was in 1971. In 2005, dissolved oxygen levels returned to normal after Hurricane Katrina re-aerated the water in late August, but the *Karenia brevis* bloom persisted (NOAA, 2005b). Unusually high marine turtle mortalities were reported in July and continued into September. At about the same time, a *Karenia brevis* bloom occurred in the Florida Panhandle, closing shellfish harvesting areas for an extended period of time. In September, *Karenia brevis* blooms were also reported along the south Texas coast.

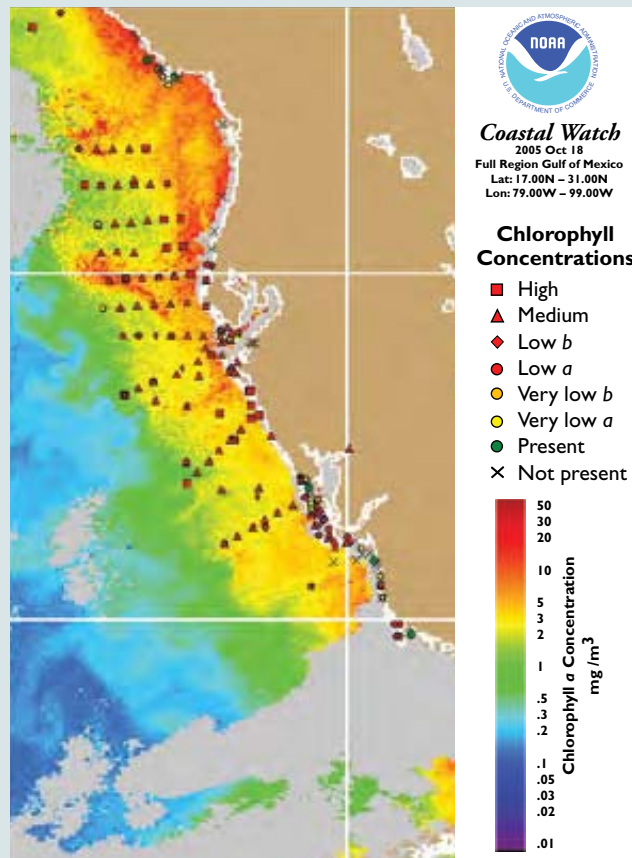
Many agencies and institutions are involved in addressing this HAB problem. NOAA, EPA, and the State of Florida, in partnership with academic institutions, local governments, and business organizations, have undertaken major initiatives to understand and predict the occurrence of *Karenia brevis* blooms, improve monitoring and early warning identification of bloom events, investigate the effects on threatened species, and test newly developed control strategies. The U.S. Navy Office of Naval Research and the DOI Minerals Management Service (MMS) have also contributed to studies of optics, physical oceanography, and modeling. The NSF and National Institute of Environmental Health Studies (NIEHS) have funded studies related to the nutrient sources for blooms and the effects of brevetoxins on human health.

In the past few years, there have been many advances in our understanding of *Karenia brevis*. In 1999, NOAA, with ground-truthing data provided by the HAB monitoring program conducted by the Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute, began developing a system that utilizes satellite imagery to help detect and monitor blooms. By 2004, this effort had significantly expanded and included models for projecting transport of the HABs using improved analysis of satellite data and meteorological conditions to predict likely impacts of the HABs. In October 2004, the forecast effort in Florida became operational as NOAA's Gulf of Mexico

Harmful Algal Bloom Forecasting System. The system produces an HAB Forecasting System Bulletin, which is now provided twice a week on an operational basis to federal, state, and local officials. The bulletin contains a written summary and analysis of bloom's levels and extent, which are also illustrated in maps (see figure). The bulletin is a resource used to guide sampling efforts, assist in management decisions, and provide information to the public (NOAA, 2007e). As of September 2005, more than 70 bulletins were provided to state and local managers during the 2005 HAB event, with more than 90% of the bulletins being used (Fisher et al., 2006).

The recently completed NOAA- and EPA-funded regional Florida project studied the occurrence and causes of *Karenia brevis* blooms for 5 years and developed a coupled physical/biological model to better understand environmental factors controlling blooms. Although the physiological and optical properties, bloom maintenance, termination, and transport of *Karenia brevis* are better understood, the nutrient sources supporting blooms and the trophic transfer and affects of brevetoxins on higher trophic levels require further study.

Other efforts related to *Karenia brevis* HABs are also underway. Several agencies have supported the development of an optical sensor that can discriminate between *Karenia brevis* and most other phytoplankton (NOAA, 2005b). The sensor can be deployed on ships and Autonomous Underwater Vehicles for mapping and on moorings for continuous, real-time monitoring. NOAA is supporting the use of these new optical sensors as part of a networked system of autonomous sampling platforms, incorporating physical/chemical-sensor and bio-sensor packages to provide data for predictive models and to guide statewide adaptive field sampling. An effort is planned by NOAA to implement these as part of the dataset for the HAB Forecasting System Bulletin. In addition, after a series of laboratory feasibility studies, a recent field pilot project was conducted to test the efficacy of spraying a clay slurry on a *Karenia brevis* bloom to make the cells fall to the bottom without releasing their toxin. Although similar methods have been used in Asia, this was the first time a control method was tested under field conditions in the United States.



Map from Gulf of Mexico HAB Bulletin for October 20, 2005, showing data from September 30, 2005 (NOAA, 2005c).

Mackerel Fisheries

King and Spanish mackerel are two coastal pelagic (water-column-dwelling) fish species that inhabit the Gulf of Mexico LME. Coastal pelagic fish are fast swimmers that school and feed voraciously, grow rapidly, mature early, and spawn over many months. U.S. and Mexican commercial fishermen have harvested Spanish mackerel since the 1850s and king mackerel since the 1880s.

The total catch of king mackerel from the Gulf of Mexico LME averaged 3,467 t per fishing year from 1981 to 2000, with maximum landings of 5,599 t in 1982 and minimum landings of 1,368 t in 1987. In 2001, the total catch was 3,649 t, with the recreational sector accounting for an average 62% of the total catch. From 1986 to 1996, landings were consistently above the total allocated catch, and by 1997, the Gulf of Mexico Fishery Management Council had increased the total allocated catch to 4,812 t. Until recently, the Gulf of Mexico LME king mackerel stock was considered overfished because of previous overexploitation of the fishery, and since 1985, the stock has been managed under rigid rebuilding schedules. In 2003, the maximum sustainable yield for the king mackerel stock in the Gulf of Mexico LME was estimated at 5,175 t. Results from the 2004 stock assessment suggest that the stock is not overfished and that overfishing is not occurring. At present, the commercial fishery for Gulf of Mexico LME king mackerel has restrictions on minimum size, regional quota allocations, trip catch limits, and gear restrictions. Although controlling the harvest of recreational fisheries is complex and the degree of compliance is not clear, the recreational fishery is regulated with restrictions on minimum size and bag limits (NMFS, In press).

The U.S. and Mexican commercial fishery for Spanish mackerel began in the waters off of New York and New Jersey, but has shifted southward over time to southern U.S. Atlantic and Gulf of Mexico waters. A major recreational fishery also exists for Spanish mackerel throughout its range, and the percent of landings by recreational anglers has increased to account for about 80% of Gulf of Mexico LME landings for the stock. The total catch of Spanish mackerel in the Gulf of Mexico LME averaged 2,081 t per fishing year from 1984 to 2001, with maximum landings of 4,586 t in 1987



Recreational anglers account for a significant portion of the landings of king and Spanish mackerel from the Gulf of Mexico LME (courtesy of NOAA).

and minimum landings of 995 t in 1996. Catches dropped substantially (about 50%) in 1995–1996 because of a gill-net ban in Florida waters, where a major portion of the commercial catch took place. In 2001, the total catch was 1,737 t. Since 1989, the landings of Spanish mackerel from this LME have been consistently below the total allocated catch, and total landings have been about 50% of the total allocated catch since 1995. The 2003 stock assessment indicated that the stock is currently exploited at the optimum long-term yield level (similar to the long-term potential yield, but modified for economic, social, or ecological factors), but not overfished. At present, management restrictions for the commercial fishery of Spanish mackerel in the Gulf of Mexico LME include minimum-size restrictions and quota allocation, as well as gear restrictions in state waters. Minimum size and daily bag restrictions are in place for the recreational fishery. Current issues affecting this stock involve mainly the bycatch of juveniles in the shrimp trawl fishery (NMFS, In press).

Shrimp Fisheries

In the Gulf of Mexico LME, shrimp have been fished commercially since the late 1800s. Brown, white, and pink shrimp are found in all U.S. Gulf of Mexico LME waters shallower than 395 feet. Most of the offshore brown shrimp catch is taken at depths of about 130 to 260 feet; white shrimp in waters 66 feet deep or less; and pink shrimp in

waters approximately 130 to 200 feet deep. Brown shrimp are most abundant in the waters off the coast between Texas and Louisiana, and the greatest concentration of pink shrimp is in the waters off the coast of southwestern Florida (NMFS, In press).

Landings of brown, white, and pink shrimp in the Gulf of Mexico LME have varied over the years (Figure 5-20). Gulf of Mexico LME brown and white shrimp landings increased significantly from the late 1950s to around 1990, but landing levels during most of the 1990s were below these maximum values. In 2000, landing levels were extremely good for both species, with near-record levels reported. Landings in 2001–2003 were below these record catch levels, but were still well above average for both species. Pink shrimp landings remained stable until about 1985 and then declined to an all-time low in 1990. During the mid-1990s, landings increased to above-average levels, but have again shown a moderate declining trend in recent years. The numbers of young brown, white, and pink shrimp entering the fisheries (level of recruitment) have generally reflected the level of catch for each species (NMFS, In press).

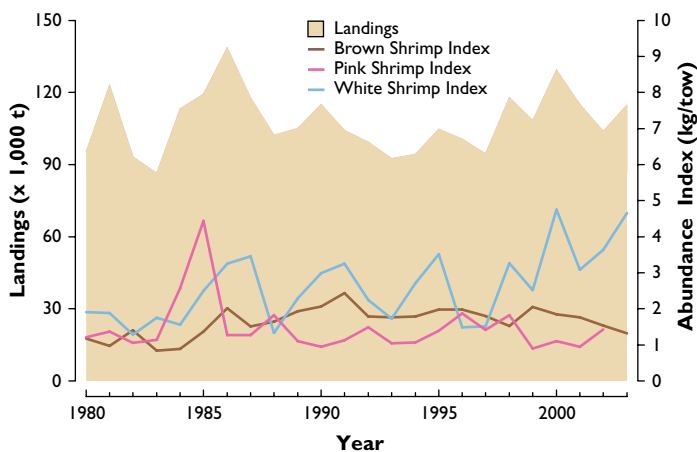


Figure 5-20. Shrimp landings in thousands of metric tons (t) and abundance index in kg/tow from the U.S. waters of the Gulf of Mexico LME, 1980–2003 (NMFS, In press).

Recruitment overfishing has not been evident in the Gulf of Mexico LME for any of the shrimp stocks. The number of young brown shrimp produced per parent increased significantly until about 1991 and has remained near or slightly below

that level during most years. White and pink shrimp recruitment levels have not shown any general trend. Although pink shrimp stocks rebounded from the low values experienced in the early 1990s, they have started to decline again in recent years. The increase in brown shrimp recruitment appears related to marsh habitat alterations due to coastal subsidence and sea-level rise in the northwestern portion of this LME. These alterations cause the intertidal marshes to be inundated with water for longer periods of time, allowing the shrimp to feed for longer periods within the marsh area. Both factors have also expanded estuarine areas, created more marsh edges, and provided more protection from predators. As a result, the nursery function of these marshes has been greatly magnified, and brown shrimp production has expanded. However, continued subsidence or additional sea-level rise will lead to marsh deterioration, an ultimate loss of supporting wetlands, and the decline of currently high fishery yields (NMFS, In press).

Catch rates for both brown and white shrimp were at high levels for the 2001 harvesting season. Landings in 2004 were up 1% from the 2003 landings of 115,566 t, and U.S. landings of 116,519 t from the Gulf of Mexico LME were the nation's largest, representing 83% of the national total. All three of the commercial shrimp species are being harvested at maximum levels. Maintenance of shrimp stocks above the overfishing index levels should prevent overfishing of these populations (NMFS, In press). Regulations in the FMP for shrimp (GMFMC, 2004b) restrict shrimping through the closure of two shrimping grounds. There is a seasonal closure of fishing grounds off Texas for brown shrimp and a closure off Florida for pink shrimp. Size limits also exist for white shrimp caught in federal waters and landed in Louisiana. Because it has been shown that environmental factors determine production, negative effects on habitat have the potential to cause future reductions in shrimp catch. The loss of habitat, such as the destruction of wetland nurseries and the expansion of the hypoxic zone in Louisiana waters, may cause future declines in the shrimp harvest (NMFS, In press).

Highlight

Mobile Bay National Estuary Program Habitat Strategic Assessment for Coastal Alabama

The Mobile Bay NEP led a strategic assessment process to examine habitat needs and deficiencies in coastal Alabama. The goal was to identify, examine, and prioritize sites of particular sensitivity, rarity, or value for potential acquisition and/or restoration using a multi-species approach. This assessment resulted in the identification of 17 priority sites for acquisition (or other conservation/protection options) and more than 30 other sites/habitat types where restoration and/or enhancement are considered necessary (Yeager, 2006). Identification of sites for acquisition or where restoration was considered necessary was based in part on data developed in Efroymsen Coastal Alabama Conservation workshops held in December 2003 and March 2004 in a partnership between the Mobile Bay NEP and The Nature Conservancy. This assessment can be used by the state and other government organizations to more effectively guide resource management activities in coastal Alabama. Indeed, some state and local agencies and organizations have already acquired or are working to acquire certain sites on the priority site list (Yeager, 2006). Similarly, restoration activities are underway or are being planned in a number of the identified areas.

The need for such an assessment arose from the lack of coordination and communication among the many organizations and government agencies actively pursuing habitat acquisition, preservation restoration, and management activities in the Mobile Bay area. Through the strategic assessment process, the contributions of existing preservation and management programs and the capabilities of all agencies and organizations involved in these programs are coordinated and maximized.

The process was organized by the Mobile Bay NEP to carry out habitat action plans contained in its *Comprehensive Conservation and Management Plan* (Mobile Bay NEP, 2002) and was funded by the EPA's Gulf of Mexico Program (U.S. EPA, 2007a). The assessment involved an active partnership with The Nature Conservancy in hosting a workshop to examine possible conservation strategies and conservation targets for topics such as ecological systems and species, stresses, and threats. The findings of this workshop provided critical background information to assist attendees of subsequent workshops in the discussion of possible sites for acquisition, protection, and restoration, as well as the development of strategies for accomplishing these activities. Other participants in this strategic assessment covered a wide spectrum of federal, state, and public- and private-interest groups,



River delta wetland habitat (courtesy of Mobile Bay NEP).

including the USACE, FWS, the USDA's Natural Resources and Conservation Service (NRCS), the Mississippi–Alabama Sea Grant Consortium, the Alabama Department of Conservation and Natural Resources, the Alabama Forest Resources Council, the Weeks Bay NERR, the Mobile and Baldwin county governments, the Mobile Bay Audubon Society, the Dauphin Island Bird Sanctuary, the Alabama Coastal Foundation, the Alabama Power Company, and other local conservationists and realtors.

Although long-term success will be judged on the degree to which identified sites are protected or restored, short-term results are promising. For example, sites identified in the habitat strategic assessment have also been included as priorities for acquisition in recent state planning documents in response to the Coastal and Estuarine Land Protection Program (Yeager, 2006). Furthermore, efforts to create a coastal habitat restoration database are in progress. The Mississippi–Alabama Sea Grant Consortium initiated this database and funded its development to track ongoing restoration projects. The Mobile Bay NEP will be responsible for managing and maintaining the database as part of its data management system (Mississippi–Alabama Sea Grant Consortium and Mobile Bay NEP, 2007). Finally, a steering committee called the Coastal Habitats Coordinating Team has been created to promote a continuing focus on habitat needs. The Mobile Bay NEP will work to develop the public–private partnerships necessary to effectively conserve critical habitats throughout coastal Alabama.



Dune habitat (courtesy of Mobile Bay NEP).



Coastal marsh habitat (courtesy of Mobile Bay NEP).

Habitat conservation, protection, and restoration are very much a community concern in coastal Alabama. The development of effective partnerships and tools, such as the strategic assessment process, has helped the Mobile Bay NEP better utilize and target existing capabilities, resources, and funding for achieving habitat goals and assist in coordinating and maximizing various individual organization efforts.

Impact of Hurricanes Katrina and Rita

Since mid-September 2005, NOAA/NMFS has undertaken surveys of the northern Gulf of Mexico LME in areas affected by Hurricanes Katrina and Rita to assess the quality of marine resources used in seafood products and to determine if these events resulted in changes in the abundance or distribution of important shrimp, crab, and finfish species. NMFS will re-survey the northern Gulf of Mexico LME area periodically to determine the abundance of species and examine the potential for nursery area disruptions caused by habitat damage in coastal wetlands. Data obtained from the Gulf of Mexico LME abundance survey conducted in October and November 2005 provide a baseline from which to evaluate short-term storm impacts and long-term recovery actions. NMFS evaluated wetland restoration projects underway in the Louisiana wetlands and barrier islands after the hurricanes. Eight of nine projects functioned as intended to protect and begin to restore degraded habitats; however, approximately 100 mi² of wetlands in the

southeastern Louisiana marshes were lost because of Hurricane Katrina. Studies are underway to evaluate the effect of Hurricane Katrina on the fishery value of shallow wetland nurseries (NMFS, In press).

NOAA announced in January 2006 that Hurricanes Katrina and Rita did not cause a reduction in fish and shrimp populations in the offshore areas of the Gulf of Mexico LME. The annual survey of shrimp and demersal (bottom-dwelling) fish completed in November 2005 showed that some species, such as the commercially valuable and overfished red snapper, had a higher abundance index in 2005 than the average calculated for the period of 1972 to 2004. The survey also showed that the abundance index for Atlantic croaker doubled. The overall abundance indices of shrimp and demersal fish increased by about 30% from 2004 levels, largely due to increases in Atlantic croaker, white shrimp, and red snapper populations. The reduction in fishing activities in the Gulf of Mexico LME since the hurricanes could be a factor contributing to the abundance index increases for some of the shorter-lived species (NOAA, 2006b).



Hurricane Katrina interrupted fishing activities in the Gulf of Mexico LME by destroying fishery infrastructure, such as the shrimp boats and barges shown here in Venice, LA (courtesy of Lieut. Commander Mark Moran, NOAA).

Assessment and Advisory Data

Fish Consumption Advisories

In 2003, 14 fish consumption advisories were in effect for the estuarine and marine waters of the Gulf Coast. Most of the advisories (12) were issued for mercury, and each of the five Gulf Coast states had one statewide coastal advisory in effect for mercury levels in king mackerel. The statewide king mackerel advisories covered all coastal and estuarine waters in Florida, Mississippi,

Louisiana, and Alabama, but covered only the coastal shoreline waters in Texas. As a result of the statewide advisories, 100% of the coastal miles of the Gulf Coast and 23% of the estuarine square miles were under advisory in 2003 (Figure 5-21).

Species and/or groups under fish consumption advisory in 2003 for at least some part of the coastal waters of the Gulf Coast region

Barracuda	King mackerel
Blue crab	Ladyfish
Bluefish	Little tunny
Catfish	Permit
Crab	Red drum
Cobia	Shark
Gafftopsail catfish	Snook
Gag grouper	Spanish mackerel
Greater amberjack	Spotted seatrout
Creville jack	Wahoo

Source: U.S. EPA, 2004b



South Padre Island, TX (courtesy of Alisa Schwab).

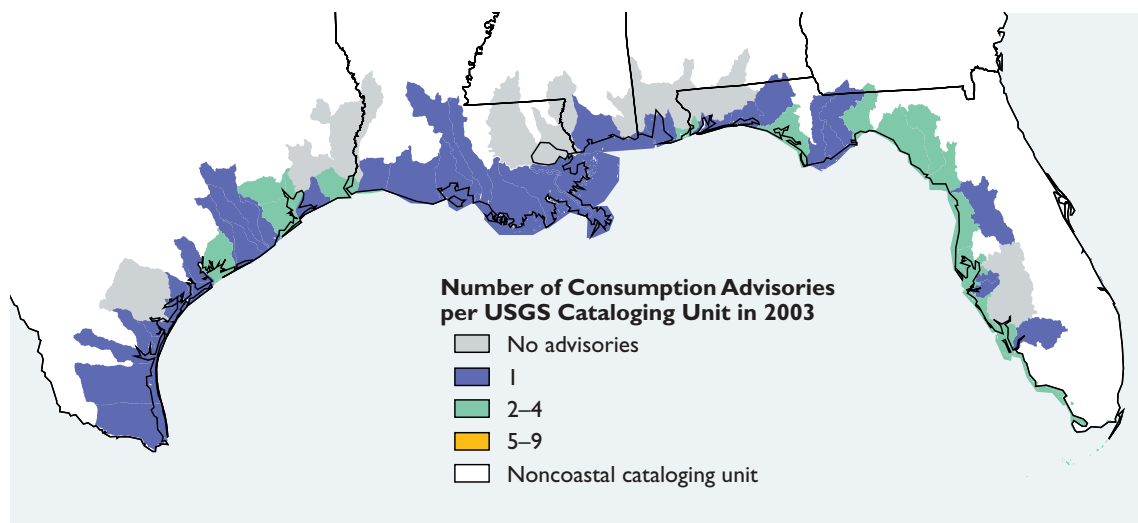


Figure 5-21. The number of fish consumption advisories active in 2003 for the Gulf Coast coastal waters (U.S. EPA, 2004b).

Fish consumption advisories placed on specific waterbodies included additional fish species. Florida had six mercury advisories in effect for a variety of fish, in addition to the statewide coastal advisory. In Texas, the Houston Ship Channel was under advisory for all fish species because of the risk of contamination by chlorinated pesticides and PCBs. Potential dioxin contamination in catfish and blue crabs resulted in additional advisories for the Houston Ship Channel. Figure 5-22 shows the number of advisories issued along the Gulf Coast for each contaminant (U.S. EPA, 2004b).

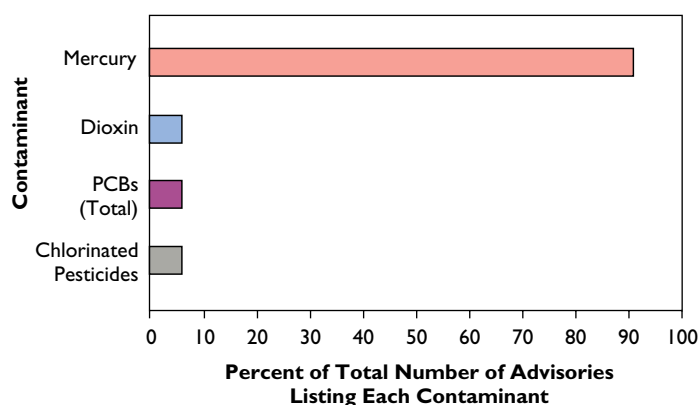


Figure 5-22. Pollutants responsible for fish consumption advisories in Gulf Coast coastal waters. An advisory can be issued for more than one contaminant, so percentages may add up to more than 100 (U.S. EPA, 2004b).

Beach Advisories and Closures

Of the 619 coastal beaches in the Gulf Coast region reported to EPA, 23.3% (144 beaches) were closed or under an advisory for some period of time in 2003. Table 5-1 presents the numbers of beaches monitored and under advisory or closure for each state. As shown in the table, Florida's west coast had the most beaches with advisories or closures, and Louisiana did not report any data for EPA's 2003 survey. Figure 5-23 presents advisory and closure percentages for each county within each state (U.S. EPA, 2006c).

Table 5-1. Number of Beaches Monitored and With Advisories/Closures in 2003 for Gulf Coast States (U.S. EPA, 2006c)

State	No. of Beaches Monitored	No. of Beaches With Advisories/Closures	Percentage of Beaches Affected by Advisories/Closures
Florida (Gulf Coast)	407	103	25.3
Alabama	25	10	40.0
Mississippi	21	11	52.3
Louisiana	NR	NR	NR
Texas	166	20	12.3
TOTAL	619	144	23.3

NR = Not Reported.

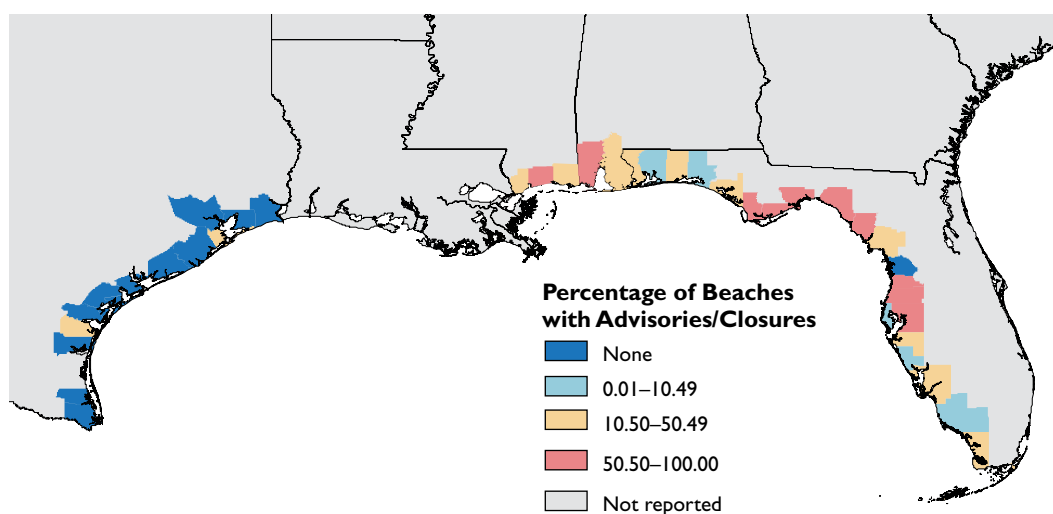


Figure 5-23. Percentage of monitored beaches with advisories or closures, by county, for the Gulf Coast region (U.S. EPA, 2006c).

Most beach advisories and closings were implemented at coastal beaches along the Gulf Coast because of elevated bacteria levels (Figure 5-24). Figure 5-25 shows that unknown sources accounted for 99% of the responses (U.S. EPA, 2006c).

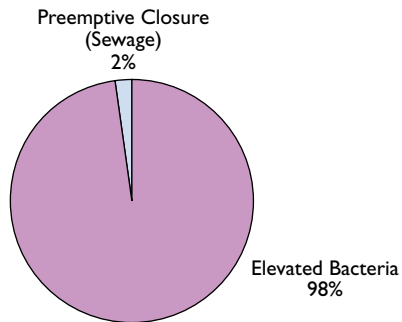


Figure 5-24. Reasons for beach advisories or closures for the Gulf Coast region (U.S. EPA, 2006c).

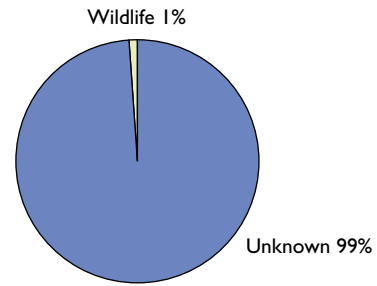


Figure 5-25. Sources of beach contamination resulting in beach advisories or closures for the Gulf Coast region (U.S. EPA, 2006c).



Galveston, TX (courtesy of Oscar Boleman).

Summary



Based on the indicators used in this report, the overall condition of Gulf Coast coastal waters is rated fair to poor. Coastal wetland loss, sediment quality, and benthic condition are rated poor in Gulf Coast coastal waters for 2001–2002, and water quality was also of concern (rated fair). Benthic index values were lower than expected in 45% of the Gulf Coast coastal area. Although elevated sediment contaminant concentrations were found in only 2% of the coastal area, sediments were toxic in 13% of the coastal area. Decreased water clarity and elevated DIP concentrations were observed in more than 22% of the coastal area, and elevated levels of chlorophyll *a* were observed in 7% of the area. DIN and dissolved oxygen concentrations rarely exceeded guidelines. The overall condition rating of 2.2 in this report represents only a slight decrease from the rating of 2.4 observed in the previous report (NCCR II), but still represents an improvement in overall condition since the early 1990s. Increasing population pressures in the Gulf Coast region warrant additional monitoring programs and increased environmental awareness to correct existing problems and to ensure that indicators that appear to be in fair condition do not worsen.

NOAA's NMFS manages several fisheries in the Gulf of Mexico LME, including reef fishes, menhaden, mackerel, and shrimp. Of the dominant reef fishes, red snapper and red grouper are currently overfished, and the gag grouper and greater amberjack are approaching an overfished condition. These issues are being addressed with regulatory measures and stock-rebuilding plans. The menhaden stock in this LME is healthy, and catches are generally below long-term maximum sustainable yield estimates. The Gulf of Mexico LME king and Spanish mackerel are currently not overfished, but the Spanish mackerel stock is exploited at its optimum long-term yield. Recruitment overfishing is not evident in any of the Gulf shrimp stocks; however, all three of the commercial shrimp species are being harvested at maximum levels. Loss of habitat has the potential to cause future reductions in shrimp catch.

Contamination in Gulf Coast coastal waters has affected human uses of these waters. In 2003, there were 14 fish consumption advisories in effect along the Gulf Coast, most of which were issued for mercury contamination. In addition, approximately 23% of the region's monitored beaches were closed or under advisory for some period of time during 2003. Elevated bacteria levels in the region's coastal waters were primarily responsible for the beach closures and advisories.